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# Low Permeability of Core-forming Melts in Olivine Spinel

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Separation of the metallic core from the silicate mantle of a planetary body by porous flow of Fe-Ni-S-O melt through a solid matrix is viewed as unlikely because metal-rich melts, due to their high melt-solid interfacial energy, do not wet silicate grains at low pressures, precluding formation of an interconnected melt at low melt fraction, and leading to isolated melt pockets with a permeability of zero. At higher pressures increased solubility of oxygen in the metal-sulfide melt may reduce its interfacial energy against silicate minerals and allow the metal-sulfide melt to interconnect.

To address this suggestion, we have performed experiments at pressures up to 9 GPa to determine the microstructure of metallic melts in an olivine matrix. All melts with less than 50% S+O remain non-interconnected and there is no visible trend towards a reduced interfacial angle with increasing pressure. An experiment was performed at 14 GPa and 1500°C to test whether Fe-Ni-S-O melts wet high-pressure olivine spinel. 10 GPa eutectic composition Fe-Ni sulfide was added to <38 micron olivine along with (Mg,Fe) oxide to ensure oxygen saturation in the melt. This mixture was encapsulated in a diamond capsule during the 5 hour multi-anvil run.

Sulfide remained distributed throughout the charge both as inclusions in the silicate spinel and at grain corners. The approx. 7 vol. % sulfide melt showed no tendency to gravitationally segregate. Neither the increase in oxygen solubility with pressure nor the modified crystal structure are sufficient to create a wetting melt that can percolate towards the core along grain boundaries.

These results imply that separation of core from mantle must occur via silicate liquid/metal sulfide liquid separation at high temperatures in a magma ocean, either in smaller bodies that then accreted as differentiated bodies or as separation within an undifferentiated Earth close to its present size.

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